



**QUADRANT SR-6,000**  
**Sequence Of Operation**

**OXIDIZER PRESTART MODE:**

The operator switches the TSS Control Panel disconnect to the "ON" position. (*CPI recommends not shutting off the disconnect unless the system is being stored, or maintenance is being completed.*) The PLC will scan the following items to ensure that they are in the correct position:

1. The Oxidizer Gas Control Valve (CV142) Low Fire Switch (ZSL144) is closed.
2. The Oxidizer Main Gas Shut-Off Valve (SOV134) is closed.
3. The Oxidizer Main Gas Block Valve (BV137) is closed.
4. The Oxidizer Low Gas Pressure Switch (PSL133) is closed.
5. The Oxidizer High Gas Pressure Switch (PSH139) is closed.
6. The Oxidizer High Temperature Limit Switch is made, indicating a safe condition.
7. The Pressure Blower Pressure Switch (PSL224) is open.
8. The E-Stop circuit is not open.
9. Booster fan VFD (VFD251) fault contact is NOT present.
10. High duct pressure switch (PSH248) is open.
11. The Combustion Air Blower Pressure Switch (PDS217) is open.
12. The Oxidizer temperature (TE190) no sensor break.
13. The Oxidizer temperature (TE191) no sensor break.

If any of the above safety contacts are not made, the PLC shall alarm, prohibit any further sequencing, and indicate which safety is not made. If all safeties are made, the system will remain in this state until an operator chooses to start the system. The operator interface will display, "**OFFLINE AWAITING RESTART**".

The operator has (6) pages to choose from on the main operator interface screen...

1. "START/STOP SYSTEM"- This page gives the operator the ability to:
  - Start and stop function of the oxidizer system
  - Resetting alarms.
2. "OXIDIZER STATUS"- This page gives status of the oxidizer.
  - Temperatures of Oxidizer. TE190, TE191
  - Oxidizer Burner Status. (Off, Ramping Up, At Temperature)
  - Gas valve position. E143
  - Pressure blower on/off status. BLO223



3. "DUCT BURNER"- This page gives status and selection of the Duct Burner.
  - Mill request to run
  - Mill Heat selection – Duct burner
  - Temperatures of Duct Burner.
  - Duct burner status (Off, Ramping Up, At Temperature)
  - Duct burner gas air control valve positions. 0-100%
  - Duct Burner Combustion Air Blower ON/OFF Status.
  - Booster fan speed in hertz. VFD251
  - Booster fan: Auto or Manual
  - Mill Pressure PT249
4. "PID CONTROL" – PASSWORD PROTECTED – This page allows access to control temperature set point, alarm set points, and PID tuning parameters.
5. "MAINTENANCE"- PASSWORD PROTECTED – This page allows the operator to manually start fans and move actuators while the system is down for maintenance.
  - Maintenance can be accessible if line is not selected.
6. "ALARM HISTORY"- This page shows history of alarms.

#### **OXIDIZER START SEQUENCE:**

If the operator selects the "START/STOP SYSTEM" page.

The operator selects the oxidizer "RESET" key to clear any possible faults.

If the operator then selects the "START" key from the operator interface on the oxidizer control panel. The following sequence is initiated:

1. The PLC will energize an oxidizer start bit, internal to the PLC.
2. The PLC will energize the pressure blower (BLO223) motor starter and the Combustion Air Blower (BLO213) motor starter.
  - The operator interface will display, "**STARTING BLOWERS**".
3. When the PLC receives the Combustion Air Blower Pressure Switch (PDS217) input and the pressure blower pressure switch (PSL224), the PLC will energize the booster fan VFD (VFD251) start command and force it to the preset idle speed setpoint. (adjustable setpoints located inside a secured screen)
4. The PLC will set an internal blowers running bit.

#### **OXIDIZER SYSTEM PURGING SEQUENCE:**

1. When the PLC sees the internal blowers running bit, the Booster Fan pressure switch (PDS252), the combustion air blower pressure switch (PDS217), the pressure blower



pressure switch (PSL224), and no faults are present, the PLC will energize the Flame Safety Start output.

- The operator interface will display: **SYSTEM PURGING**
2. The Oxidizer Flame Safety will now start purging. When the purge is complete the Flame safety will energize the pilot gas solenoids (SV102 and SV103) and the ignition transformer (IT178) for 4 seconds to attempt pilot ignition.
    - If the flame safety does not see a pilot flame, the flame safety will display a fault. The PLC will log the fault in an internal counter and then reset the flame safety relay to try again. The flame safety will re-purged and the above pilot ignition sequence is repeated. The sequence will be repeated for a total of 3 attempts and after the third attempted with no flame sensed on flame safety, the PLC will stop sequencing, shut the system down to the offline awaiting restart condition, signal an alarm, and display on the operator interface **"PILOT FLAME FAULT"**. This will require the operator to acknowledge/reset the oxidizer on the interface. If the pilot is established, the sequence will continue.
  3. Once the pilot flame is established on the flame safety, the flame safety will power the main gas shut-off valve (SOV134), blocking valve (BV137) to open 100% and close the vent valve (SVV136).
  4. When the proof of "OPEN" switch is made on the blocking valve, the PLC will display on the operator interface **"OXIDIZER MAIN FLAME ESTABLISHED"**.
  5. The PLC will start an Oxidizer Main Flame 10 Second Stabilization Timer. When the timer runs out the sequence will continue.

Once main flame is established the PLC will allow the booster fan to go into volume control as well as starting the heating up process.

#### **OXIDIZER TEMPERATURE RAMPING UP SEQUENCE:**

1. After the 10 second stabilization timer has expired and the main gas shutoff valve is open, the PLC will release the Oxidizer Gas Control valve (E143) to ramp up to its burner operating set point.
2. The operator interface will display: **OXIDIZER TEMPERATURE RAMPING UP**
3. When the oxidizer temperature reaches 1350°F (located in the high temperature controller) and the main gas valves are open, the PLC will start a 1 minute stabilization timer.
4. When the timer has expired and the main gas valves are opens, the PLC will energize the "OXIDIZER READY" contact.
5. The operator interface will display: **OXIDIZER AT READY TEMPERATURE.**



6. If the PLC had energized the "OXIDIZER READY" contact and if the Mill has a request to run present and the booster fan is in PID control, the PLC will energize the corresponding line "RUN PERMISSIVE" output.
  - The operator interface will display: **PROCESS FEEDING OXIDIZER**

#### **VOLUME CONTROL SEQUENCE:**

When the Oxidizer Main Flame 10 second stabilization timer times out, if the "REQUEST TO RUN" contact is present and the mill was selected to start and the oxidizer main gas valve is open (SOV134) and the oxidizer main gas blocking valve is open (BV137) AND no sensor break pressure transmitter(PT249) , the PLC will:

- Release the Booster Fan VFD (VFD251) to PID control based off the process variable from the pressure transmitter (PT249).

#### **WATER ADDITION SEQUENCE:**

When the Booster Fan VFD (VFD251) is in PID volume control based off the process variable from the pressure transmitter (PT249), and the PLC receives the "WATER BEING ADDED TO MILL" input, the PLC will:

- Increase the speed of the Booster Fan VFD (VFD251) by 10%, a value adjustable from a secured screen in the operator interface.
- Hold VFD251 at that speed until the "WATER BEING ADDED TO MILL" input is lost plus an additional 10 seconds, a value adjustable from a secured screen in the operator interface.
- Once the timer has expired the fan will go back into volume control.

#### **DOOR(S) OPEN SEQUENCE:**

When the Booster Fan VFD (VFD251) is in PID volume control based off the process variable from the pressure transmitter (PT249), and the PLC receives the "MILL DOOR OPEN" (LSHX open contact) input, the PLC will:

- Will go to a set point (adjustable from a secured screen in the operator interface).
- Once the input is removed the fan will go back into volume control.



### **SAND ADDITION SEQUENCE:**

When the Booster Fan VFD (VFD251) is in PID volume control based off the process variable from the pressure transmitter (PT249), and the PLC receives the "SAND BEING ADDED TO MILL" input, the PLC will:

- Will go to a set point (adjustable from a secured screen in the operator interface).
- Once the input is removed the fan will go back into volume control.

### **CYCLONE DOUBLE DUMP VALVE SEQUENCE:**

When the PLC sees the internal blowers running bit, the Booster Fan pressure switch (PDS252), the PLC will energize solenoid valve (SV582). Wait 5 second, the PLC will energize solenoid valve (SV582) again second time. After solenoid valve (SV582) is energized for a second time, and the PLC will wait 5 second before energize solenoid valve (SV584). After waiting 5 second, the PLC will energize solenoid valve (SV584) again second time. The PLC will repeat this sequence after a setpoint of 60 seconds. This will be an adjustable setpoint located inside a secured screen. If the "REQUEST TO RUN" contact is no longer present, and the PLC will stop repeating this sequence.

### **DUCT BURNER HEAT SELECTION:**

The selection on the operator interface:

- Duct Burner
- No Heat

As one is selected the other is automatically deselected.

#### **Duct Burner Selected:**

If the request to run is present and the Duct Burner is selected and the oxidizer main gas valve is open (SOV134) and the main gas blocking valve is open (BV137) and the booster fan is in volume control and the oxidizer shutdown is not selected, the PLC will:

1. The PLC will energize an internal Duct Burner Start bit
2. Energize the duct burner combustion air blower motor starter (MS613).
3. When the PLC sees the combustion air blower motor starter run contact (AUX613) and the combustion air blower pressure switch (PDS617) and no high temperature alarm from the thermocouple (TE691), the PLC will energize the duct burner flame safety system to "Start" output.
4. The Duct Burner Flame Safety will now start purging. When the purge is complete the Flame safety will energize the pilot gas solenoids (SV602 and SV603) and the ignition transformer (IT678) for 4 seconds to attempt pilot ignition.

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5. Once the pilot flame is established on the flame safety, the flame safety will power the main gas shut-off valve (SOV634), blocking valve (BV637) to open 100% and close the vent valve (SVV636).
6. When the proof of "OPEN" switch is made on the shutoff and blocking valve, the PLC will display on the operator interface **"DUCT BURNER FLAME ESTABLISHED"**.
7. When the proof of "OPEN" switch is made on the shutoff and blocking valve, the PLC will start a Duct Burner Main Flame 10 second stabilization timer. When the timer runs out the sequence will continue.
8. After the 10 second stabilization timer has expired, the PLC will release the Duct Burner Gas Control valve (E643) to ramp the temperature up at a ramp rate of 50 degrees a minute (ramp rate will be in a secured screen).
9. Once the duct burner flame has been established the operator interface will display: **DUCT BURNER TEMPERATURE RAMPING UP**
10. When the temperature reaches 400°F (located in the high temperature controller), the PLC will start a 1 minute stabilization timer.
11. When the timer has expired the PLC will energize the "DUCT HEATER READY" contact.
12. The operator interface will display: **DUCT HEATER AT READY TEMPERATURE.**

### **EVACUATION ROUTINE:**

If the PLC sees a fault after the Oxidizer Main Flame 10 Second Stabilization Timer has expired and the oxidizer main gas valve is open and the oxidizer blocking valve is open, the PLC will force the system to the following conditions:

- De-energize the oxidizer flame safety.
- De-energize the oxidizer ready contact
- De-energize all Run Permissive
- De-energize the duct burner start bit.
  
- Energize the pressure blower motor starter
- Energize the combustion air blower motor starter
- Energize the booster fan VFD start outputs
- Force the booster fan VFD to the manual preset speed of 30 Hz. (Adjustable from a secured screen)

### **OXIDIZER EMERGENCY SHUT DOWN (ESTOP):**

The operator presses the emergency stop button. The following sequence is initiated:

1. The PLC will remove all outputs.
  - The PLC will drop out the "OXIDIZER READY" and "RUN PERMISSIVE" contacts to the customer.

- The PLC will remove power from the duct burner flame safety (FS2), which will close the main gas shutoff valve and the main gas blocking valve which will shut off the burner.
  - The PLC will remove power from the oxidizer flame safety (FS1), which will close the main gas shutoff valve and the main gas blocking valve which will shut off the burner.
  - The PLC will drop out the booster fan VFD "RUN" contact which will shut off the booster fan VFD.
  - The PLC will remove the "RUN" contact from the pressure blower and all combustion air blowers, which will shut off the blowers.
  - The PLC will remove all outputs to solenoids which will close all solenoids.
2. The PLC will sound an alarm, advance the E-Stop counter (a visual indication inside the operator interface screen) and display "**E-STOP SELECTED**".

#### **OXIDIZER NORMAL SHUT-DOWN SELECTED:**

The operator selects the Oxidizer Shutdown button from the operator interface. The following sequence is initiated:

1. The operator interface will display: **OXIDIZER SHUTDOWN TEMPERATURE RAMPING DOWN**
2. The PLC will remove the "OXIDIZER READY" and "RUN PERMISSIVE" contacts.
3. The PLC will start a 30 second timer to clear any remaining VOC's in the duct.
4. When the timer has expired the sequence will continue.
5. The PLC will de-energize the duct burner start bit.
6. The PLC will begin a ramp down of the oxidizer to the shut-off temperature of 600°F and start a shutdown timer of 60 minutes. The PLC will shut the burner off when the timer or temperature is reached. These are adjustable set points located in the operator interface.
7. The PLC will force the booster fan VFD to go to the idle fixed speed setpoint.
8. Once the oxidizer shut-down temperature has been reached, the PLC will remove power to the oxidizer flame safety which will close the main gas shut-off valve (SOV134), the main gas blocking valve (BV137) and opens the vent valve (SVV136) which will shut-off the main burner and the interface will display: **MAIN FLAME OFF**
9. The booster fan, combustion air blower and the pressure blower will continue to run in a cool-down mode. This is an adjustable timer located in the operator interface.
10. The interface will display: **COOL DOWN MODE**



11. Once the timer is completed, the interface will display: **SHUTTING DOWN FANS**
12. Once the timer is completed, the PLC will remove the VFD "RUN" contact which will de-energize the booster fan, the combustion air blower start contact (MS213) which will stop the combustion air blower, the pressure blower start contact (MS223) and will stop the pressure blower and the compressed air solenoid
13. When the PLC sees all fan and blower outputs de-energized, the operator interface will display: **FANS COASTING TO A STOP** When the PLC loses all of the fan and blower pressure switch contacts, the operator interface will display: **OXIDIZER OFFLINE AWAITING RESTART**

The PLC will continue to scan the following until the system is restarted, or the power is shutoff to the TSS control panel:

- The Oxidizer Gas Control Valve (CV142) Low Fire Switch (ZSL144) is closed.
- The Oxidizer Main Gas Shut-Off Valve (SOV134) is closed.
- The Oxidizer Main Gas Block Valve (BV137) is closed.
- The Oxidizer Low Gas Pressure Switch (PSL133) is closed.
- The Oxidizer High Gas Pressure Switch (PSH139) is closed.
- The Oxidizer High Temperature Limit Switch is made, indicating a safe condition.
- The Pressure Blower Pressure Switch (PSL224) is open.
- The E-Stop circuit is not open.
- Booster fan VFD (VFD251) fault contact is NOT present.
- The Combustion Air Blower Pressure Switch (PDS217) is open.
- The Oxidizer temperature (TE190) no sensor break.
- The Oxidizer temperature (TE191) no sensor break.

The system will wait to be restarted.

### **ALARM HISTORY PAGE:**

The PLC will log alarms/faults on this page. The operator will have the ability to scroll through the past alarms.

### **Oxidizer Shut Down Faults:**

1. The Gas Control Valve (CV142) low fire start switch (ZSL144):
  - If the main gas valve is closed AND the main block valve is closed AND the system is not in maintenance mode AND the system is not running in evacuation mode, the low fire start switch should be present. If not present, the PLC will start a 40 second timer. If the PLC does not see this contact after the timer expires, the PLC will shut



the system down to the offline awaiting restart position and alarm, **"ZSL144-GAS CV FAILED TO CLOSE"**.

2. The main gas shut-off valve (SOV134).
  - If the flame safety purge complete input is not present and the system is not running in evacuation mode, the main gas shut off valve closed input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact the PLC will shut the system down and alarm, **"SOV134-MAIN GAS VALVE FAILED TO CLOSE"**.
3. The main gas block valve (BV137).
  - If the flame safety purge complete input is not present and the system is not running in evacuation mode, the main gas block valve closed input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact the PLC will shut the system down and alarm, **"BV137-BLOCK VALVE FAILED TO CLOSE"**.
4. The main gas shut-off valve (SOV134).
  - If the flame safety purge complete input is present, the main gas shut off valve open input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact the PLC will shut the system down and alarm, **"SOV134-MAIN GAS VALVE FAILED TO OPEN"**.
  - If the oxidizer flame stabilization timer has expired and the booster fan is in PID control, the PLC will not shut the system down but go to the **"EVACUATION ROUTINE"**.
5. The main gas block valve (BV137).
  - If the flame safety purge complete input is present, the main gas block valve open input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact the PLC will shut the system down and alarm, **"BV137-BLOCK VALVE FAILED TO OPEN"**.
  - If the oxidizer flame stabilization timer has expired and the booster fan is in PID control, the PLC will not shut the system down but go to the **"EVACUATION ROUTINE"**.
6. The pressure blower pressure switch (PSL224).
  - If the pressure blower motor starter is energized the PLC will start a 40 second timer. If the PLC does not see the input prior to the timer expiring, the PLC will shut the system down and alarm, **"PSL224-PRESSURE BLOWER PRESSURE SWITCH FAULT"**.
  - If the switch is lost and the starter output is energized and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and the booster fan is in PID control, the PLC will not shut the system down but go to the **"EVACUATION ROUTINE"**.



- If the pressure blower motor starter is not energized, the PLC will start a 40 second timer. If the PLC sees the input after the timer expiring, the PLC will shut the system down and alarm, **"PSL224-PRESSURE BLOWER PRESSURE SWITCH FAULT"**.
- 7. The combustion air blower pressure switch (PDS217).
  - If the combustion air blower motor starter is energized the PLC will start a 40 second timer. If the PLC does not see the input prior to the timer expiring, the PLC will shut the system down and alarm, **"PDS217-COMBUSTION AIR BLOWER PRESSURE SWITCH FAULT"**.
  - **If the switch is lost and the starter output is energized and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and at least (1) booster fan is in PID control, the PLC will not shut the system down but go to the "EVACUATION ROUTINE"**.
  - If the combustion air blower motor starter is not energized, the PLC will start a 40 second timer. If the PLC sees the input after the timer expiring, the PLC will shut the system down and alarm, **"PDS217-COMBUSTION AIR BLOWER PRESSURE SWITCH FAULT"**.
- 8. The low gas pressure switch (PSL133).
  - If the input is not present the PLC will start a 1 second timer. If the input is not present by the time it expires, the PLC will shut the system down and alarm, **"PSL133-LOW GAS PRESSURE SWITCH FAULT"**.
  - **If the switch is lost and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and the booster fan is in PID control, the PLC will not shut the system down but go to the "EVACUATION ROUTINE"**.
- 9. The high gas pressure switch (PSH139).
  - If the input is not present the PLC will start a 1 second timer. If the input is not present by the time it expires, the PLC will shut the system down and alarm, **"PSH139-HIGH GAS PRESSURE SWITCH FAULT"**.
  - **If the switch is lost and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and the booster fan is in PID control, the PLC will not shut the system down but go to the "EVACUATION ROUTINE"**.
- 10. The high temperature limit switch.
  - If the input is not present and the flame stabilization timer is not complete and the main gas valve and block valves are not open, the PLC will start a 1 second timer. If the input is not present by the time it expires, the PLC will shut the system down and alarm, **"TE191-OXIDIZER HIGH TEMPERATURE"**.
  - **If the switch is lost and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and the booster fan is in PID control, the PLC will not shut the system down but go to the "EVACUATION ROUTINE"**.
- 11. The estop circuit is not open.



- The PLC will constantly monitor this contact. If at any time the contact opens the PLC will shut the system down and alarm, **"E-STOP SELECTED OR TE191 HIGH HIGH TEMPERATURE"**.
- 12. The combustion air blower motor starter (MS213).
  - If the output to start the blower is energized, the run input should be present. If not, the PLC will start a 2 second timer. If the contact is not present prior to the timer expiring, the PLC will shut the system down and alarm **"MS213-COMBUSTION AIR BLOWER MOTOR STARTER FAULT"**.
- 13. The pressure blower motor starter (MS223).
  - If the output to start the blower is energized, the run input should be present. If not, the PLC will start a 2 second timer. If the contact is not present prior to the timer expiring, the PLC will shut the system down and alarm **"MS223-PRESSURE BLOWER MOTOR STARTER FAULT"**.
- 14. The flame safety.
  - If the start flame safety is energized and the purge complete is not present and a flame safety fault is present, the PLC will log 1 to a counter in the PLC and reset the flame safety. If the counter gets to 3, the PLC will stop sequencing, shut the system down to the offline awaiting restart condition, signal an alarm, and display on the operator interface **"FLAME SAFETY FAULT"**.
  - If the purge complete is present and a flame safety fault is present, the PLC will shut the system down and alarm, **"UV177-FLAME LOSS"**.
  - If the fault is present and the oxidizer flame stabilization timer has expired and the booster fan is in PID control, the PLC will not shut the system down but go to the **"EVACUATION ROUTINE"**.
- 15. The oxidizer thermocouple (TE190) sensor break.
  - If the oxidizer thermocouple (TE190) has a sensor break, the PLC will shut the system down to the offline awaiting restart condition, signal an alarm, **"TE190-OXIDIZER THERMOCOUPLE SENSOR BREAK"**.
  - If the fault is present and the oxidizer flame stabilization timer has expired and the booster fan is in PID control, the PLC will not shut the system down but go to the **"EVACUATION ROUTINE"**.

#### **Duct Heater Shutdown Faults:**

1. The duct burner outlet high temperature (TE690) limit is present.
  - If the PLC does not see the limit, the PLC will start a 3 second timer. If the limit is not present when the timer expires. The PLC will de-energize the Duct burner start bit and alarm, **"TE690 DUCT HEATER OUTLET HIGH TEMPERATURE EXCEEDED"**.
2. The duct burner outlet temperature (TE691) is greater than its set point.



- If the PLC sees the temperature greater than the setpoint, the PLC will start a 3 second timer. If the temperature is still greater than the setpoint. The PLC will de-energize the duct burner start bit and alarm, **"TE691 DUCT HEATER OUTLET HIGH TEMPERATURE EXCEEDED"**.
- 3. The duct burner outlet high high temperature (TE690) limit is present.
  - If the PLC does not see the limit. The PLC will de-energize the duct burner start bit and alarm, **"TE690 DUCT HEATER OUTLET HIGH HIGH TEMPERATURE EXCEEDED OR E-STOP SELECTED"**.
- 4. The duct heater combustion air blower pressure switch (PDS617).
  - If the combustion air blower motor starter is energized the PLC will start a 40 second timer. If the PLC does not see the input prior to the timer expiring, the PLC will de-energize the duct burner start bit and alarm, **"PDS617- DUCT HEATER COMBUSTION AIR BLOWER PRESSURE SWITCH FAULT"**.
  - If the switch is lost and the starter output is energized and the duct burner flame stabilization timer has expired and the duct burner main gas shut off valve is open, the PLC will de-energize the duct burner start bit and alarm, **"PDS617- DUCT HEATER COMBUSTION AIR BLOWER PRESSURE SWITCH FAULT"**.
  - If the combustion air blower motor starter is not energized, the PLC will start a 40 second timer. If the PLC sees the input after the timer expiring, the PLC will de-energize the duct burner start bit and alarm, **"PDS617- DUCT HEATER COMBUSTION AIR BLOWER PRESSURE SWITCH FAULT"**.
- 5. The Gas Control Valve (CV642) low fire start switch (ZSL644):
  - If the duct burner main gas valve is closed AND the duct burner main block valve is closed OR the system is not in maintenance mode, the low fire start switch should be present. If not present, the PLC will start a 40 second timer. If the PLC does not see this contact after the timer expires, the PLC will de-energize the duct burner start bit and alarm, **"ZSL644- DUCT HEATER GAS CV FAILED TO CLOSE"**.
- 6. The low gas pressure switch (PSL633).
  - If the input is not present the PLC will start a 1 second timer. If the input is not present by the time it expires, the PLC will de-energize the duct burner start bit and alarm, **"PSL633- DUCT HEATER LOW GAS PRESSURE SWITCH FAULT"**.
- 7. The high gas pressure switch (PSH639).
  - If the input is not present the PLC will start a 1 second timer. If the input is not present by the time it expires, the PLC will de-energize the duct burner start bit and alarm, **"PSH639- DUCT HEATER HIGH GAS PRESSURE SWITCH FAULT"**.
- 8. The main gas shut-off valve (SOV634).
  - If the flame safety purge complete input is not present, the main gas shut off valve closed input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact, the PLC will de-energize the duct burner start bit and alarm, **"SOV634- DUCT HEATER MAIN GAS VALVE FAILED TO CLOSE"**.



9. The main gas block valve (BV637).
  - If the flame safety purge complete input is not present, the main gas block valve closed input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact, the PLC will de-energize the duct burner start bit and alarm, **"BV637- DUCT HEATER BLOCK VALVE FAILED TO CLOSE"**.
10. The main gas shut-off valve (SOV634).
  - If the flame safety purge complete input is present, the main gas shut off valve open input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact, the PLC will de-energize the duct burner start bit and alarm, **"SOV634- DUCT HEATER MAIN GAS VALVE FAILED TO OPEN"**.
11. The main gas block valve (BV637).
  - If the flame safety purge complete input is present, the main gas block valve open input should be present. If not, the PLC will start a 15 second timer. If the timer expires and the PLC does not see this contact, the PLC will de-energize the duct burner start bit and alarm, **"BV637- DUCT HEATER BLOCK VALVE FAILED TO OPEN"**.
12. The booster fan differential pressure switch (PDS252).
  - If the booster fan VFD output is energized, the PLC will start a 40 second timer. If the PLC does not see the input prior to the timer expiring, the PLC will shut the system down and alarm, **"PDS252- BOOSTER FAN PRESSURE SWITCH FAULT"**.
  - If the switch is lost and VFD output is energized and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and the booster fan is in PID control, the PLC will not shut the system down but go to the **"EVACUATION ROUTINE"**.
  - If the booster fan VFD is not energized, the PLC will start a 40 second timer. If the PLC sees the input after the timer expiring, the PLC will shut the system down and alarm, **"PDS252 – BOOSTER FAN PRESSURE SWITCH FAULT"**.
13. The booster fan VFD (VFD251) fault.
  - If the input is not present the PLC will start a 1 second timer. If the input is not present by the time it expires, the PLC will shut the system down and alarm, **"VFD251- BOOSTER FAN VFD FAULT"**.
14. The booster fan VFD Run (VFD251).
  - If the output to start the VFD is energized, the run input should be present. If not, the PLC will start a 2 second timer. If the contact is not present prior to the timer expiring, the PLC will shut the system down and alarm. **"VFD251-BOOSTER FAN VFD RUN FAULT"**.
15. The high duct pressure switch (PSH248).
  - If the input is present the PLC will start a 1 second timer. If the input is still present by the time the timer expires, the PLC will shut the system down and alarm, **"PSH248- HIGH DUCT PRESSURE SWITCH FAULT"**.



16. The booster fan outlet temperature (TE192) is greater than its set point.
  - If the PLC sees the temperature greater than the setpoint, the PLC will start a 3 second timer. If the temperature is still greater than the setpoint. The PLC will shut the system down and alarm, **"TE192 BOOSTER FAN OUTLET TEMPERATURE EXCEEDED"**.
  - **If the temperature is greater than the setpoint and the oxidizer flame stabilization timer has expired and the main gas shut off valve is open and the booster fan is in PID control, the PLC will not shut the system down but go to the "EVACUATION ROUTINE"**.
17. The thermocouple (TE691) sensor break.
  - If the thermocouple (TE691) has a sensor break, the PLC will de-energize the duct burner start bit and alarm, **"TE691- THERMOCOUPLE SENSOR BREAK"**.
18. The pressure transmitter (PT249) sensor break.
  - If the pressure transmitter (PT249) has a sensor break, the PLC will de-energize the duct burner start bit and alarm, **"PT249- PRESSURE TRANSMITTER SENSOR BREAK"**.
19. The duct heater flame safety.
  - If the duct heater start flame safety is energized and the purge complete is not present and a flame safety fault is present, the PLC will log 1 to a counter in the PLC and reset the flame safety. If the counter gets to 3, the PLC will de-energize the duct burner start bit and alarm, **"DUCT HEATER FLAME SAFETY FAULT"**.
  - If the purge complete is present and a duct heater flame safety fault is present, the PLC will de-energize the duct burner start bit and alarm, **"UV677- DUCT HEATER FLAME LOSS"**.

### **Oxidizer Warnings:**

1. The loss of temperature (TE191)
  - If the PLC loses the Oxidizer Ready input, after it has already established it for 1 minute, the PLC will start a 30 second timer. When the timer expires, the PLC will alarm, **"TE191-OXIDIZER LOSS OF TEMPERATURE"**. **Note if this occurs this should remove the Run Permissive to customer and keep the system running.**
2. The Oxidizer thermocouple (TE192) sensor break.
  - If the oxidizer thermocouple (TE192) has a sensor break, the PLC will alarm, **"TE192- THERMOCOUPLE SENSOR BREAK WARNING"**.

### **Mill Warnings:**

1. The pressure transmitter (PT249).



- If the booster fan (VFD251) is in volume control and the PV is greater than the high alarm SP the PLC will start a 10 second timer. If the PV is still greater the PLC will display a warning only, **"PT249-HIGH PRESSURE WARNING"**
- If the booster fan (VFD251) is in volume control and the PV is less than the low alarm SP the PLC will start a 10 second timer. If the PV is still less than the PLC will display a warning only, **"PT249-LOW PRESSURE WARNING"**
- 2. The loss of temperature (TE690)
  - If the PLC loses the ready input, after it has already established it for 1 minute, the PLC will start a 30 second timer. When the timer expires, the PLC will alarm, **"TE690-LOSS OF TEMPERATURE WARNING"**. **Note if this occurs keep the system running.**
- 3. The differential pressure transmitter (PT286).
  - If the booster fan (VFD251) is in volume control and the PV is greater than the high alarm SP the PLC will start a 10 second timer. If the PV is still greater the PLC will display a warning only, **"PT286-HIGH PRESSURE WARNING-CLEAN CHAIN FILTER"**. **Note if this occurs keep the system running.**
- 4. The Mill Doors Limit Switch (LSHX)
  - If the PLC loses the Mill Doors Limit Switch (LSHX) Contact, after it has already established it for 1 minute, the PLC will start a 10 second timer. When the timer expires, the PLC will alarm, **"LSHX- MILL DOOR OPEN WARNING"**. **Note if this occurs keep the system running.**
- 5. The Mill Outlet Damper Closed Limit
  - If the PLC receives the Mill Outlet Damper Closed Limit, the PLC will start a 10 second timer. When the timer expires, the PLC will alarm, **"MILL OUTLET DAMPER CLOSED WARNING"**. **Note if this occurs keep the system running.**

#### **PID PAGE:**

**SECURED PID SCREEN: PASSWORD (0019)**

#### **OXIDIZER TEMPERATURE:**

- **ADJUSTABLE OXIDIZER TEMPERATURE SET POINT RANGE: 0-1600F**
- **ADJUSTABLE OXIDIZER TEMPERATURE GAS VALVE- GAIN, RATE, AND RESET –**

#### **OXIDIZER SHUTDOWN TEMPERATURE:**

- **ADJUSTABLE OXIDIZER SHUTDOWN TEMP SETPOINT RANGE: 0-1600F**

#### **OXIDIZER TEMPERATURE RAMP RATE:**

- **ADJUSTABLE OXIDIZER TEMP RAMP RATE SET POINT RANGE: 10-50F/PER MIN**

#### **DUCT BURNER TEMPERATURE:**

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- ADJUSTABLE DUCT BURNER TEMPERATURE SET POINT RANGE: 0-600F
- ADJUSTABLE DUCT BURNER TEMPERATURE GAS VALVE- GAIN, RESET, AND RATE

**DUCT BURNER TEMPERATURE RAMP RATE:**

- ADJUSTABLE DUCT BURNER TEMP RAMP RATE SET POINT RANGE: 10-50F /PER MIN

**BOOSTER FAN VFD:**

- ADJUSTABLE BOOSTER FAN VFD SETPOINT: 0 TO -1"WC
- ADJUSTABLE BOOSTER FAN IDLE SPEED: 15 TO 60 HERTZ
- ADJUSTABLE BOOSTER FAN VFD- GAIN, RATE, AND RESET

**COOL DOWN TIMER:**

- ADJUSTABLE COOL DOWN TIMER RANGE: 0 TO 3600 SECONDS

**MAINTENANCE PAGE:**

**SECURED MAINTENANCE SCREEN: PASSWORD (007)**

**Any selection on this page must be made with the oxidizer shutdown.**

**The operator will need to select a key for the "MAINTENANCE SCREEN". The PLC will request a password, if the correct password is entered; the PLC will allow access to the maintenance screen. If an incorrect password is entered, the PLC will signal "ACCESS DENIED" and stay on the password screen. The operator will have the choice to return to other screens if needed. When the correct user name and password is entered the operator will have the following choices below.**

Booster fan (BF251) Select:  
Booster Fan Hertz: Range 0 to 60 Hertz  
Booster fan (BF251) Deselect:

Pressure Blower (BLO223) Select:  
Pressure Blower (BLO223) De-select:

Combustion Air Blower (BLO213) Select:  
Combustion Air Blower (BLO213) De-select:

Gas Control Valve (E143) Select:  
Gas Control Valve %: Range 0 to 100%  
Gas Control Valve (E143) Deselect:





Duct Heater Combustion Air Blower (BLO613) Select:  
Duct Heater Combustion Air Blower (BLO613) De-select:

Duct Heater Gas Control Valve (E643) Select:  
Duct Heater Gas Control Valve %: Range 0 to 100%  
Duct Heater Gas Control Valve (E643) Deselect: